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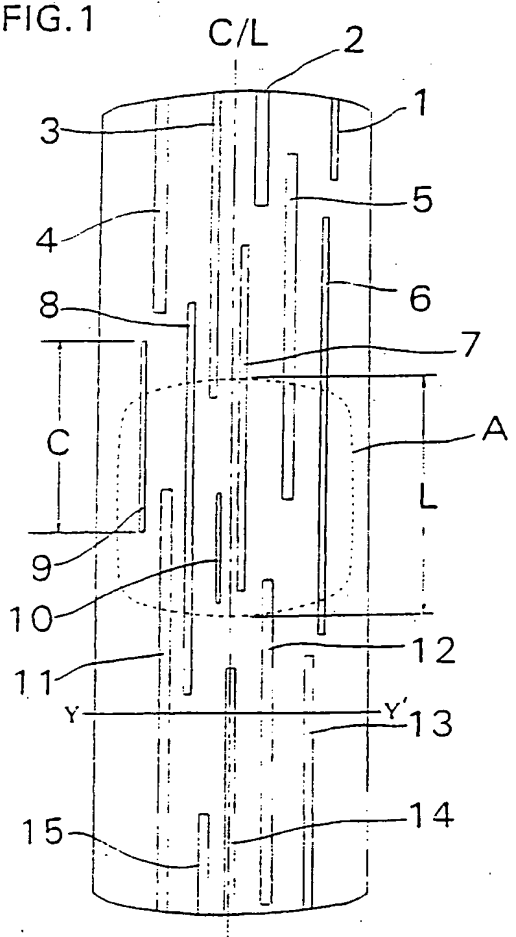
(54) Vehicle tyre

(57) A vehicle tyre comprising a ground contacting tread having a plurality of circumferentially extending longitudinal grooves (1-15) spaced apart across the axial width of the tread to divide the tread into circumferentially extending tread ribs characterised in that the longitudinal grooves are discontinuous and have at least three different lengths in the circumferential direction and circumferentially adjacent longitudinal grooves are displaced relative to each other in the axial direction such that each extends in a different plane.

FIG.1



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Description

This invention relates to a vehicle tyre having a ground contacting tread which is particularly adapted to be quiet in running and has improved performance in wet conditions.

The problem of tyre generated noise is the subject of increasingly stricter legislation concerned with reducing overall noise levels generated by moving vehicles. Thus the problem of minimising tyre generated or so-called "pass-by" noise is becoming an increasingly important aspect of tyre design.

In order for tyres to perform well under all conditions it is normal for the ground contacting tread region to be provided with grooves. In wet conditions such grooves assist in clearing bulk water from the contact area between the tyre tread and the road surface and thus help prevent aquaplaning and therefore prevent loss of steering control of the vehicle.

Conventional tyre tread pattern design for good wet performance has employed circumferentially continuous straight grooves which are often relatively wide and deep. However a serious problem with such continuous straight grooves is noise generated by the so-called "organ-pipe phenomenon" by which resonance occurs in the air-space formed by the groove of the moving tyre and the road surface which acts like a musical pipe. The particular problem with continuous circumferential grooves is that the length of the 'organ-pipe' in the tyre contact area is sufficiently great to generate frequencies which are close to those most troublesome to a driver and which also tend to reinforce other resonances occurring between the tyre and the road surface.

In previous attempts to reduce the 'organ-pipe' phenomenon. protuberances or constructions have been placed in the circumferential grooves in order to suppress or disturb the resonance. Such groove modifications have not only failed to mitigate the tyre noise problem but have also shown a detrimental effect on the wet performance of the tyre by impeding the flow of water through the grooves.

Accordingly it is an object of the present invention to overcome the above-mentioned problems and provide a tyre having a low noise tread pattern with improved wet performance.

According to one aspect of the present invention a tyre comprises a ground contacting tread having a plurality of circumferentially extending longitudinal grooves spaced apart across the axial width of the tread to divide the tread into circumferentially extending tread ribs characterised in that the longitudinal grooves are discontinuous and are of at least three different lengths in the circumferential direction and circumferentially adjacent longitudinal grooves are displaced relative to each other in the axial direction such that each groove extends in a different plane.

Preferably at least five different lengths of longitudinal grooves or more preferably at least nine different lengths are provided. Most preferably the longitudinal grooves are each a different length to each of the others.

Also the longitudinal grooves may have a circumferential length in the range of 0.5 to 2.0 times the maximum length of the ground contacting area in the condition that the tyre is mounted on its scheduled rim and inflated to its scheduled pressure and subjected to its scheduled load.

The tyre may also have axial grooves extending between two or more longitudinal grooves to divide the tread ribs into rows of tread blocks.

In a preferred embodiment the longitudinal grooves are each straight grooves disposed at 0 to the tyre circumferential direction.

Further aspects of the invention will become apparent from the following description by way of example only, of one embodiment with reference to the accompanying drawings in which:-

Figure 1 shows a view of a tyre tread according to the present invention:
Figure 2 shows a cross-section of a pneumatic tyre according to the present invention having the tread shown in Figure 1 taken in a radial plane through Y-Y':
Figure 3 shows the results of an aquaplaning test:
Figure 4 shows the results of a passby noise test: and
Figure 5 is a tyre tread pattern comprising continuous circumferential grooves.

Shown in cross-section in Figure 2 is a pneumatic tyre according to the present invention and having a conventional radial construction. Accordingly the tyre has a carcass ply 21 comprising radial cords extending between bead regions 25 through sidewall regions 27 and a tread region 23. In each bead region the carcass ply 21 is secured by being turned around a circumferentially extending inextensible bead core 22 from the axially inside to the outside. The tyre tread region 23 is reinforced by a belt or breaker 26 disposed radially outward of the carcass 21.

On the radially outer surface of the tread region 23 there are provided a series of circumferentially extending full depth tread grooves. As shown in Figure 1 these longitudinal tread grooves 1-15 are discontinuous in the circumferential direction. According to the present invention the circumferential lengths C of the longitudinal grooves 1-15 have at least three different values. Preferably the grooves have at least five and more preferably at least nine different lengths C. In the embodiment shown in Figure 1 the grooves have the most preferable configuration in that they are all different in length.

It is also preferable that the lengths of the circumferential grooves 1-15 are between half and twice the circumferential length L of the tread/ground contact area A denoted in Figure 1 by the broken line.

Also according to the present invention tread

grooves which are circumferentially adjacent are disposed in different axial positions with respect to each other. Thus in Figure 1 each of the pair of grooves 1 & 5. 5 & 12. 2 & 7. 3 & 10. 8 & 15. 4 & 9. 6 & 13. 5 & 12 etc. are disposed at different axial positions with respect to the tread centreline C/L. Most preferably as in Figure 1 each circumferentially extending tread groove 1-15 is disposed in a unique axial position.

The discontinuous tread grooves may be all the same axial widths or may have differing widths as shown. Also whilst they may extend at an acute angle to the circumferential centreline C/L. preferably they are substantially parallel to the centreline C/L as shown in the present embodiment.

A tyre tread pattern according to the present invention has shown reduced levels of noise with improved wet performance.

To illustrate the above improved properties tyres according to the present invention having the pattern shown in Figure 1 were tested against comparative example tyres of the same size and construction having a conventional pattern of four straight circumferential grooves shown in Figure 5. Both types of tyre had the same overall rubber-to-groove area or so-called 'land/sea' ratio of 70/30 and both had the same overall groove volume.

The wet performance of the tyres was assessed by evaluating the resistance to aquaplaning by means of the so-called "spin-up" test. In this test the vehicle rear brakes are disconnected and the vehicle is driven at a constant speed and in a straight line into deep water lying on smooth concrete. The brakes are then applied to lock the front wheels and thus cause aquaplaning. The brakes are then released and the time taken for the front wheels to spin-up to same speed as the rear wheels is measured electronically. A shorter 'spin-up' time is indicative of a better aquaplaning resistance. Results of tests on both tyre types at speeds from 70 to 90kph are shown in Figure 3. from which it can be seen that the tyres of the present invention had significantly shorter 'spin-up' times and thus markedly improved aquaplaning resistance over the conventional comparative tyres at all speeds.

For an assessment of noise performance a passby noise test was carried out using a front wheel drive vehicle driven in a straight line on a smoothly textured impervious road surface conforming to ISO 10844. The vehicle had test tyres fitted to the rear wheels and slick tyres fitted to the front wheels. All the tyres were inflated to their scheduled pressure and run at 80% of their rated maximum load. Shown in Figure 4 are the noise results of the vehicle coasting at 80kph. It is evident from the noise spectra presented in Figure 4 that the tyre of the present invention was quieter than the conventional comparative over the entire frequency range of 200 to 2.400Hz.

Whilst the present invention has been illustrated by the above-described embodiment which has only circumferential grooves the inventive tyre may also have laterally extending or transverse tread grooves. Such laterally extending grooves may extend fully through the tread ribs to divide the rib into a row of tread blocks.

Claims

1. A vehicle tyre comprising a ground contacting tread having a plurality of circumferentially extending longitudinal grooves (1-15) spaced apart across the axial width of the tread to divide the tread into circumferentially extending tread ribs characterised in that the longitudinal grooves are discontinuous and have at least three different lengths in the circumferential direction and circumferentially adjacent longitudinal grooves are displaced relative to each other in the axial direction such that each extends in a different plane.

2. A tyre according to claim 1, characterised in that the longitudinal grooves (1-15) have at least five different lengths.

3. A tyre according to either of claims 1 or 2. characterised in that the longitudinal grooves (1-15) have at least nine different lengths.

4. A tyre according to any of claims 1 to 3. characterised in that the longitudinal grooves (1-15) are all different lengths.

5. A tyre according to any of claims 1 to 4, characterised in that the longitudinal grooves (1-15) have a length in the circumferential direction in the range of 0.5 to 2.0 times the maximum circumferential length (L) of the ground contacting area (A) of the tyre tread in the condition that the tyre is mounted on its scheduled wheelrim, inflated to its scheduled pressure and subjected to its scheduled load.

6. A tyre according to any of claims 1 to 5. characterised in that all the longitudinal grooves (1-15) are displaced relative to each other such that each extends in a different plane.

7. A tyre according to any of claims 1 to 6, characterised in that the tyre tread has axially extending grooves.

8. A tyre according to any of claims 1 to 7. characterised in that the tyre tread has axially extending grooves extending between at least two longitudinal grooves (1-15) to divide the tread ribs into rows of tread blocks.

9. A tyre according to any of claims 1 to 8. characterised in that the longitudinal grooves (1-15) are dis-

posed at 0 to the tyre circumferential direction.

10. A tyre as described herein and illustrated in Figures 1 and 2.

FIG.1

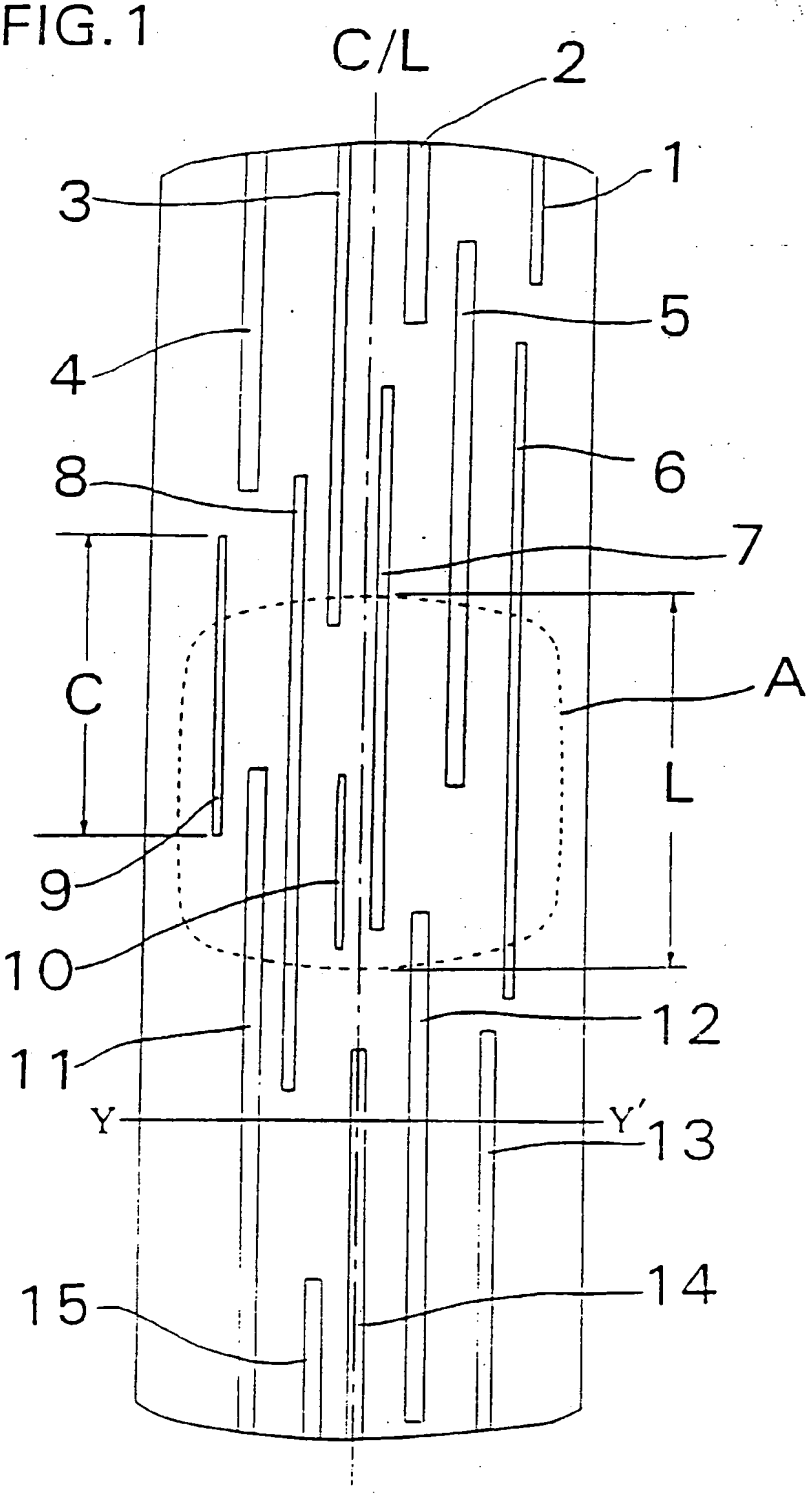


FIG. 5

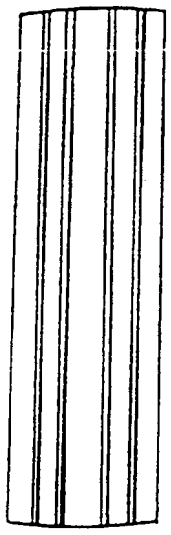
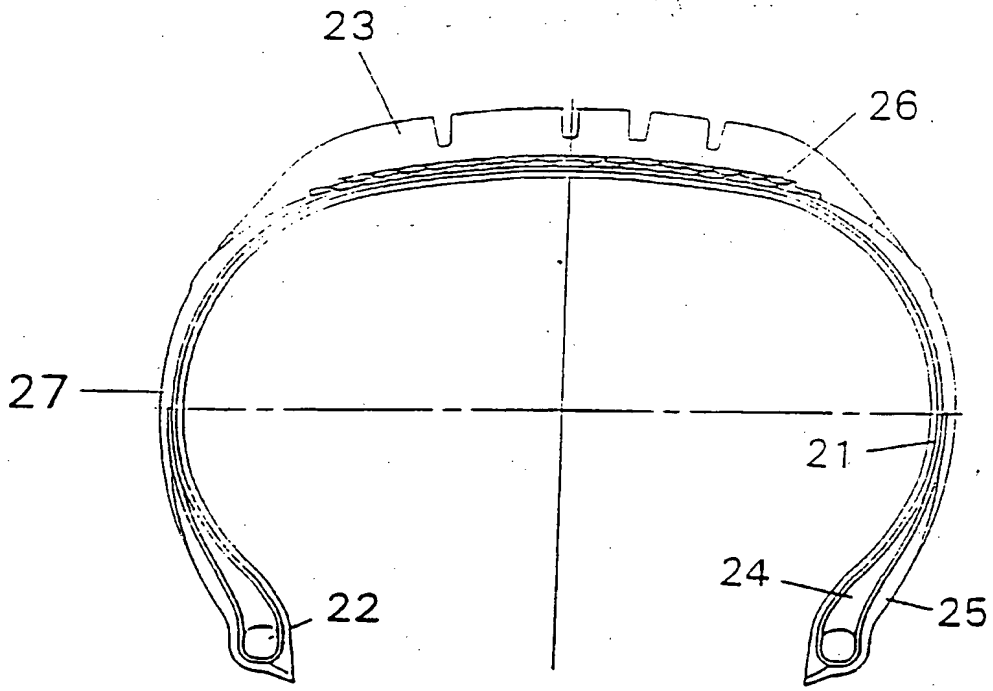


FIG. 2


23
26
27
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22

FIG. 3

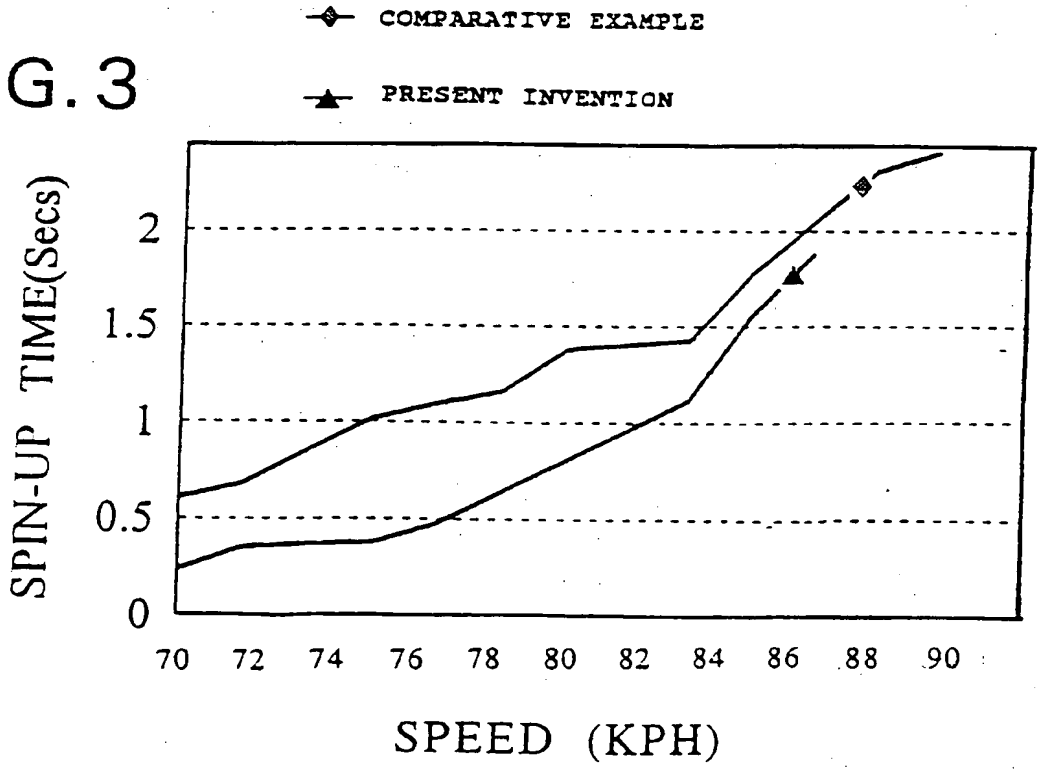
COMPARATIVE EXAMPLE
PRESENT INVENTION
SPIN-UP TIME(Secs)
2
1.5
1
0.5
0
70
72
74
76
78
80
82
84
86
88
90
SPEED (KPH)

FIG. 4